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Evaluation of Cell Membrane-Modulating Properties of Non-Ionic Surfactants with the use of Atomic Force Spectroscopy

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Abstract

© 2015, Springer Science+Business Media New York. Analytical possibilities of atomic force spectroscopy (AFS) in liquid were studied upon interaction of membranotropic polymers with the plasma membrane of human cells. Topographical visualization of tightly adherent dermal fibroblasts, but not relatively soft prostate cancer (PC-3) cells, was achieved using a conventional triangular cantilever. A microsphere-based probe has been developed and applied for AFS analysis of micromechanical properties of PC-3 cells. Non-ionic block copolymers of ethylene oxide and propylene oxide, bi-functional Pluronic® L61, and glycerol-based tri-functional copolymer (TFC) were studied as potential modulators of cellular membranes and drug delivery systems as reported by Bondar et al. (Int. J. Pharm. 461(97), 104, 2014). As indicated by dynamic light scattering and fluorescent techniques, Pluronic® L61 and TFC were adsorbed onto the cell surface and inserted into the plasma membrane in different extent. Analysis of AFS curves for surfactant-treated PC-3 cells showed that both Pluronic® L61 and TFC decreased the Young's modulus of cellular surface by almost 1.6 and 2 times, respectively. This is in accordance with the ability of amphiphilic polymers of decreasing the microviscosity of cellular membrane and promoting intracellular drug uptake as shown previously by Bondar et al. (Int. J. Pharm. 461(97), 104, 2014). Our results are of particular interest for the characterization of interaction of living cells with amphiphilic polymer-based nanocarriers and drug formulations using AFS and other surface-sensitive techniques.

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Keywords

Atomic force spectroscopy, Block copolymers of ethylene oxide and propylene oxide, Cancer cells, Cellular membranes, Elastic properties, Membrane-modulating properties, Microviscosity, Nanocarriers, Non-ionic surfactants